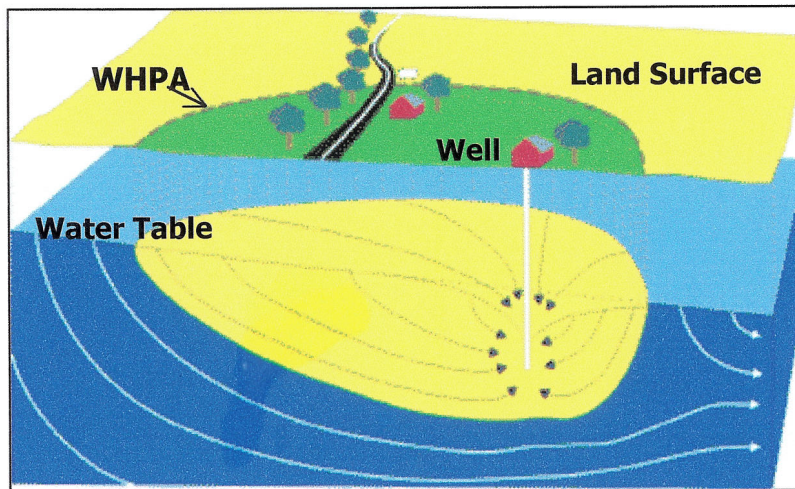


**SOURCE WATER ASSESSMENT
FOR THE OCEAN PINES WATER SUPPLY
WORCESTER COUNTY, MD**



**Prepared By
Water Management Administration
Water Supply Program
March 2000**



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SUMMARY

The Maryland Department of the Environment's Water Supply Program (WSP) has conducted a Source Water Assessment for the Ocean Pines Water System. The major components of this report as described in Maryland's Source Water Assessment Plan (SWAP) are: 1) delineation of an area that contributes water to the source, 2) an inventory of potential sources of contamination, and 3) determining the susceptibility of the water supply to contamination. Recommendations for management of the assessment area conclude this report.

The source of Ocean Pines's water supply is an unconfined aquifer in the Coastal Plain known as the Pleistocene aquifer. The system currently uses four wells to obtain its drinking water. The Source Water Assessment Area was delineated by the WSP using EPA's approved methods specifically designed for each source.

A survey to identify potential sources of contamination within the assessment area was conducted based on site visits, database review and land use maps. Well information and water quality data were also reviewed. Figures showing land uses and potential contaminant sources within the Source Water Assessment Area and an aerial photograph of the well locations are enclosed at the end of the report.

The susceptibility analysis for Ocean Pines's water supply is based on the water quality data, potential sources of contamination, aquifer characteristics, and well integrity. It was determined that Ocean Pines's water supply is susceptible to contamination by volatile organic compounds, but not susceptible to contamination by nitrate, radionuclides, synthetic organic compounds or microbiological contaminants.

INTRODUCTION

Ocean Pines is a residential community located approximately five miles west of Ocean City in Worcester County. The Ocean Pines water system is owned and operated by the Worcester County Department of Public Works (DPW), Water and Wastewater Services. The system serves a population of 10,000. The water is supplied by four wells (Nos. 2, 3, 4 and 5). Figure 1 shows the location of the supply wells.

WELL INFORMATION

A review of the well completion reports and sanitary surveys of the Ocean Pines water system indicates that three wells (Nos. 2, 3 and 4) were drilled in 1969, prior to the implementation of the State's well construction regulations in 1973. The completion report for Well No. 2 indicates that it was grouted to 50 feet. Well No. 5 was drilled in 1974 and meets the well construction standards. Table 1 contains a summary of the well construction data.

| SOURCE ID | SOURCE NAME | PERMIT | TOTAL DEPTH | CASING DEPTH | AQUIFER |
|-----------|---------------|----------|-------------|--------------|-------------|
| 01 | OCEAN PINES 2 | WO690070 | 105' | 60' | PLEISTOCENE |
| 02 | OCEAN PINES 3 | WO690069 | 107' | 62' | PLEISTOCENE |
| 03 | OCEAN PINES 4 | WO690068 | 110' | 70' | PLEISTOCENE |
| 04 | OCEAN PINES 5 | WO730351 | 97' | 60' | PLEISTOCENE |

Table 1. Ocean Pines Well Information.

Each of the supply wells has an average yield of about 500 gallons per minute (gpm).

HYDROGEOLOGY

The Ocean Pines wells obtain water from the Pleistocene aquifer which is considered to be a leaky semi-confined aquifer (Wilson, 1993). Monitoring data indicates that the water quality is sensitive to land use. Based on the MDE Monitoring Waiver Program criteria of nitrate detections of >1.0 ppm, the aquifer is considered to be unconfined. The Pleistocene aquifer (also known as the Beaverdam Sand) consists of lensoidal or roughly layered deposits of medium to very coarse sand and gravel (Weigle and Achmad, 1982). In the Ocean Pines area, the Pleistocene aquifer is overlain by the Sinepuxent Formation which consists of beds of clay, silt and fine-grained sand. The Sinepuxent Formation functions as a thin leaky confining unit for the Pleistocene aquifer (Wilson, 1993).

Based on the well completion reports for the supply wells, the average thickness for the Pleistocene aquifer and the Sinepuxent Formation were determined to be 73 feet and 15 feet, respectively. The ground water flow direction is toward the southeast at a gradient of 0.0005 (Wilson, 1993). The transmissivity of the aquifer is 7,500 ft²/day and the estimated porosity of the aquifer is assumed to be 30%.

SOURCE WATER ASSESSMENT AREA DELINEATION

For ground water systems, a Wellhead Protection Area (WHPA) is considered to be the source water assessment area for the system. WHPAs were delineated for the Ocean Pines wells in 1996 when MDE did a Wellhead Protection Plan for Ocean Pines. WHPAs were delineated using EPA's WHPA Code version 2.0, a user friendly two-dimensional ground water flow model. The permitted daily average for Ocean Pines in 1996 and at the present time is 1.0 million gallons. In order to determine the daily average pumpage for each well for the WHPA Code model, pumpage records for 1995 and 1996 were reviewed. Based on the records, the percentages pumped for each well were as follows: Well No. 2 – 7.2%, Well No. 3 – 43.4%, Well No. 4 – 17.4%, and Well No. 5 – 32%. A review of 1999 pumpage records indicates that percentages were: 24%, 35%, 4% and 37% respectively. A model run with the new well pumpage percentages did not show any significant change in the overall combined WHPA due to the total daily pumpage being similar to 1996. Mr. Jeff Hudson, the Superintendent for the water supply operations at Ocean Pines, indicated that Well No. 4's pump was being replaced hence the well pumpage was so low.

Delineation Zones

Zone 1: Zone 1 is the WHPA delineated using a 1 year time-of-travel (TOT) criterion. Zone 1 serves as the first zone of protection. The one year criterion was selected based on the maximum survival times of microbial organisms in ground water. Four Zone 1 WHPAs were delineated, one for each well (figure 2). The WHPAs are circular with diameters ranging from 500 to 1,500 feet.

Zone 2: Zone 2 is the WHPA delineated using a 10 ^{year} TOT criterion. It would take any chemical contaminant present at the Zone 2 boundary 10 years to reach the well (if it moves at the same rate as the ground water). Zone 2 provides adequate time for facilities outside the WHPA to address chemical contamination before it could reach the well.

Four Zone 2 WHPAs were delineated, one for each well (figure 2). The WHPAs for Well Nos. 3 and 5 show interference effects due to their pumpage and close proximity to each other. The circular shaped WHPAs for these two wells show some distortion around the area between these wells. The WHPAs for Well Nos. 2 and 4 do not appear to show any interference effects and are respectively oval and circular in shape.

The four Zone 2 WHPAs were combined together to form a large Zone 2 WHPA for the whole water system (figure 2). The total area of this combined Zone 2 is 387.7 acres.

POTENTIAL SOURCES OF CONTAMINATION

Several potential sources of contamination were identified in the 1996 Wellhead Protection study, all of which were outside the Ocean Pines WHPA except for a golf course – a potential non-point source of contamination. For this assessment, MDE Waste and Water Management databases were reviewed, staff consulted, and field inspections conducted, to identify potential sources of contamination in and around the Ocean Pines WHPA. In addition, MDE staff met with Mr. Jeff Hudson, Superintendent of Water Operations for Ocean Pines on December 23, 1999, to survey the WHPA and to discuss water quality concerns. No potential point sources of contamination were identified within the Ocean Pines WHPA.

Two potential point sources of contamination were identified outside the WHPA along Route 589 (see figure 2). The first one is an Underground Storage Tank (UST) site and the other is a leaking UST site. The leaking UST site is currently under investigation by MDE's Oil Control Program (Case No. 99-2912). The tank was discovered in May 1999 during an excavation of the site for property development. The tank had a capacity of 300 gallons and contained petroleum products. The tank has been removed and contaminated soil has been removed and a monitoring well drilled at the site. Soil and water samples indicate that most of the contamination is confined to the tank site. According the Oil Control Program further investigation and monitoring will continue to ensure that the contamination is contained to the site.

Based on the Maryland Office of Planning's 1997 Land Use map, the land use within the WHPA is as follows:

| LAND USE | TOTAL AREA (acres) | PERCENTAGE OF WHPA |
|----------------------------|-----------------------|-----------------------|
| Medium Density Residential | 288.2 | 74 |
| Open Urban Land | 84.7 | 22 |
| Cropland | 13.2 | 3 |
| Forest | 1.6 | <1 |

Table 2. Land Use Summary for WHPA Zones 1 and 2

Figure 3 shows the land use in and around the Ocean Pines WHPA. Within Zone 1 the land use is broken down into medium density residential (90%) and open urban land (10%).

Lawn maintenance and landscaping activities on residential land could be potential sources of nitrates and synthetic organic chemicals (pesticides) to Ocean Pines water supply. The open urban land on the northwest side Well Nos. 2 and 4 has golf courses on them. These golf courses could be potential sources of nitrate and synthetic

organic chemicals to Ocean Pines water supply due to application of fertilizers and pesticides. The cropland just west of Well 5 is used to raise corn and could also be potential sources of nitrate and synthetic organic chemicals.

A review of Maryland Office of Planning's Worcester County Sewer Map shows that 96% of land area in the WHPA is in the sewer service area (figure 4). The cropland and forest in the WHPA are the areas that have no planned sewer service.

WATER QUALITY DATA

Water Quality data was reviewed from the Water Supply Program's database and system files for Safe Drinking Water Act contaminants. The data described is from the finished (treated) water unless otherwise noted. The treatment currently in use at Ocean Pines is hypochlorination for disinfection, and pH adjustment for corrosion control. The pH adjustment is done through the addition of caustic soda (sodium hydroxide).

MDE staff met with Mr. Jeff Hudson, on December 23, 1999 to conduct a site survey and discuss any water quality concerns for Ocean Pines. Mr. Hudson indicated that main concerns were the presence of the VOC methy-tert-butyl-ether (MTBE) and the high levels of sodium.

A review of the monitoring data since 1993 for Ocean Pines's finished water indicates that the system's water supply meets the drinking water standards. No contaminant at or above 50% of the Maximum Contaminant Level (MCL) has been detected in Ocean Pines water supply since 1993.

Inorganic Compounds (IOCs)

Nitrate was detected in all the four wells at levels below 50% of the MCL. The MCL for nitrate is 10 ppm. The range of values for nitrate detected in the four wells are as follows: Well No.2 – 1.4 to 2.43 ppm; Well No. 3 – 1.4 to 4.8 ppm; Well No. 4 - 1.3 to 2.4 ppm; Well No. 5 – 1.1 to 2.56 ppm.

Sodium was detected at levels ranging from 12 ppm to 93.7 ppm. There is no MCL or secondary MCL established for sodium at the present time. The high values of the sodium can be attributed to the addition of caustic soda for corrosion control.

Volatile Organic Compounds (VOCs)

Chloroform was detected in all the wells. The range of values for chloroform detected in the four wells are as follows: Well No. 2 – 3 ppb; Well No. 3 – 1.1 to 10.2 ppb; Well No. 4 – 1.1 to 2.4 ppb; Well No. 5 - 1.9 to 8 ppb. Chloroform is a disinfection by- product and is currently regulated only for systems serving a population of over 10,000.

A composite sample of all the four wells taken on 2/11/91 showed detections of bromodichloromethane at 7 ppb, bromoform at 7 ppb chloroform at 3 ppb and

dibromochloromethane at 1ppb. All these VOCs, known as trihalomethanes, are disinfection by-products and are currently regulated for systems serving a population of over 10,000. The MCL for the regulated systems is 100 ppb for the total of these four VOCs. The disinfection by-products are the result of a reaction between chlorine used for disinfection and organic material in the water supply.

The composite sample also had a detection of dichloromethane (methylene chloride) at 9 ppb. Dichloromethane has an MCL of 5 ppb. This detection was attributed to a laboratory error, since this compound is used to clean laboratory equipment and was found in samples collected from other locations that day.

MTBE was detected in Well No. 5 at 1 ppb on 7/31/97 and at 1.5 ppb on 9/15/98. MBTE is an unregulated VOC and has no MCL. EPA has issued an advisory recommending that levels be kept at or below 20 ppb based on taste and odor concerns. Based on limited data they also believe that this level is protective of public health.

Synthetic Organic Compounds (SOCs)

Two samples collected on 6/27/95 showed detects of di (ethylexyl) phthlate at 3.71 and 2.49 ppb. This compound was found in the laboratory blank and these detects do not represent the water quality of the system. No other SOC's were detected in any samples collected between 1993 and 1995.

Radionuclides

Gross beta was detected in samples collected on 11/13/97 from Wells 2 and 3 at 2 pCi/L for each sample. Gross beta has an MCL of 50 pCi/L. It is a decay product of naturally occurring radioactive minerals in the aquifer sediments.

Microbiological Contaminants

Ground Water Under the Direct Influence of Surface Water (GWUDI) sampling was conducted for each well on 12/10/98. The results were negative for the presence of total and fecal coliform for all the wells.

SUSCEPTIBILITY ANALYSIS

LSC MHP
Ocean Pines wells obtain water from an unconfined aquifer. In general, water supplies in unconfined aquifers are susceptible to contamination from land use activities. The well completion reports for all the supply wells indicate the presence of about 10- 15 feet of silty clay beds between the surface and the well screens. These beds may inhibit the infiltration of some of the surface contaminants into the aquifer. Continued routine monitoring of contaminants is essential in assuring a safe drinking water supply.

Inorganic Compounds (IOCs)

Considered above
Nitrate has been detected in Ocean Pines water supply. The levels of nitrate have been below 50% of the MCL and there has been no pattern of any increase with time. Sources of nitrate can generally be traced to land use. Fertilization of agricultural fields and residential lawns, and on-site septic systems are non-point sources of nitrate in ground water. Nitrate present in Ocean Pines water supply may be related to the use of fertilizers in the golf courses, and residential lawns and cornfields. In addition, a lot of the Ocean Pines land use in the past was agricultural and residual nitrate may still be present in the ground water. Currently Ocean Pines water supply is **not** susceptible to nitrate, but it has the potential for susceptibility to nitrate if land use is not managed effectively.

Volatile Organic Compounds (Vocs)

VOCs have been detected in Ocean Pines water supply. Low levels of MTBE were detected twice in Well 5. There are no known potential sources of VOCs in the WHPA. Two potential sources identified are both outside the WHPA (see figure 2). The UST site is in compliance with State regulations. The leaking UST site is under investigation and initial monitoring data indicates that the contaminant flow is away from the Ocean Pines WHPA. Mr. Hudson indicated that there may be other buried leaking UST in and around the WHPA since in the past farmhouses were located on the property. Ocean Pines water supply is susceptible to VOC contamination.

Synthetic Organic Compound (SOCs)

The current land use indicates that non-point sources like cropland, golf courses and residential lawns exist within the WHPA. Pesticides used for agricultural operations and golf course and residential lawn maintenance are a potential threat. Based on data since 1993, no SOC's have been detected in the water supply. Currently, Ocean Pines water supply is **not** susceptible to SOC contamination.

Radionuclides

Gross beta radiation was detected one time in samples from Well 2 and Well 3. However the detected levels were way below 50% of the MCL for gross beta radiation. Gross beta radiation may be attributed to decay of naturally occurring minerals like uranium in the aquifer sediments. Ocean Pines water supply is **not** susceptible to radionuclides.

Microbiological Contaminants

Based on coliform sampling data, the Ocean Pines supply wells were determined **not** to be susceptible to protozoans or bacteriological contaminants. The wells may be susceptible to viral contaminants, as these are much smaller, can survive longer, and may not be as effectively filtered by the aquifer as protozoans and bacteria. Future *Add to manual* monitoring will be needed to determine susceptibility to viruses.

MANAGEMENT OF THE WHPA

Form a Local Planning Team

- The team should represent all the interests in the community. The water supplier, home association officers, the County Health Department, local planning agencies, local businesses, developers, farmers and residents within and near the WHPA should work to reach a consensus on how to protect the water supply.

Public Awareness and Outreach

- Pamphlets, flyers and bill stuffers sent to local residents, businesses, and farmers will help educate the general public about Wellhead Protection. An MDE pamphlet entitled Gardening in a Wellhead Protection Area is such an example.
- Placing signs at the WHPA boundaries is a good way to make the public aware of protecting their source of water supply.

Monitoring

- A monitoring well was drilled at the leaking UST outside the WHPA to determine VOC contamination level and extent. A supply well for another system has been drilled near the site. This well will also be sampled for VOCs.
- Monitoring wells should be installed at any new UST sites to sample for VOC contamination and ensure that such contaminants do not migrate toward the supply wells.
- Continue annual VOC and nitrate sampling, SOC sampling every 3 years and periodic sampling of radiological contaminants and other IOCs.
- Annual sampling for microbiological contaminants is a good check on well integrity.

Planning /New Development

- Adopt a local land use ordinance in cooperation with Worcester County Planning Department to protect water quality. The State of Maryland Wellhead Protection Ordinance may be used as a template.
- Planners should address future land use and recharge preservation with consideration to Wellhead Protection.
- Continue to stress the importance of a Comprehensive Water and Sewer Plan to ensure that new development (residential and commercial) adjacent to the WHPA is sewerred. Currently there is no planned sewer service for new developments along Route 589.

Land Acquisition/Easements

- The availability of loans for purchase of and or easements for the purpose of protecting water supplies is available from MDE. Loans are offered at zero percent interest and zero points.

Contingency Plan

- Comar 26.04.01.22 regulations require all community water systems to prepare and submit for approval a plan for providing a safe and adequate for providing a safe and adequate drinking water supply under emergency conditions.

Change in Uses

- Any increase in pumpage or the addition of new wells to the system will require revision of the WHPA since it is affected by pumpage. It is recommended that Ocean Pines contact the MDE Water Supply Program when an increase in pumpage is applied for or when new proposed wells are being discussed.

Contaminant Source Inventory Updates/Well Inspections

- Ocean Pines should conduct its own detailed survey to ensure that there are no other potential sources of contamination within the WHPA. Updated records of new development within the WHPA should be maintained. MDE does not regulate residential USTs due to their small capacity for storing oils and petroleum products. A record of any residential UST in the WHPA should be noted.
- Water operation personnel should have a regular inspection and maintenance program for the supply to ensure their integrity and to protect the aquifer from surficial contamination.

REFERENCES

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- Blandford, T. N., and Huyakorn, P.S., 1991, WHPA: A modular semi-analytical model for the delineation of wellhead protection areas, version 2: U.S Environmental Protection Agency, Office of Ground Water Protection, Washington, D.C.
- MDE, Public Drinking Water Program, 1996, A Wellhead Protection Plan for Ocean Pines, Maryland, 8 p.
- Rasmussen, W. C., and Slaughter, T. H., 1955, The ground-water resources *in* The Water Resources of Somerset, Wicomico, and Worcester Counties: Maryland Department of Geology, Mines and Water Resources Bulletin 16 pages 1-469.
- Weigle, J.M., and Achmad, G., 1982, Geohydrology of the freshwater aquifer system in the vicinity of Ocean City, Maryland, with a section on simulated water-level changes: Maryland Geological Survey Report of Investigations No. 37, 55 p.
- Wilson, J. M., Review of the MDE WHPA for Ocean Pines, Maryland, 2 p.

OTHER SOURCES OF DATA

Water Appropriation and Use Permit No. WO68G010
Public Water Supply Inspection Reports
MDE Water Supply Program Oracle Database
MDE Waste Management Sites Database
Department of Natural Resources Digital Orthophoto Quarter Quadrangle for Selbyville SE
USGS Orthophoto Topographic 7.5 Minute Quadrangle, Selbyville, MD-DEL
Maryland Office of Planning 1997 Worcester Count Land Use Map
Maryland Office of Planning 1995 Worcester County Sewer Map

FIGURES

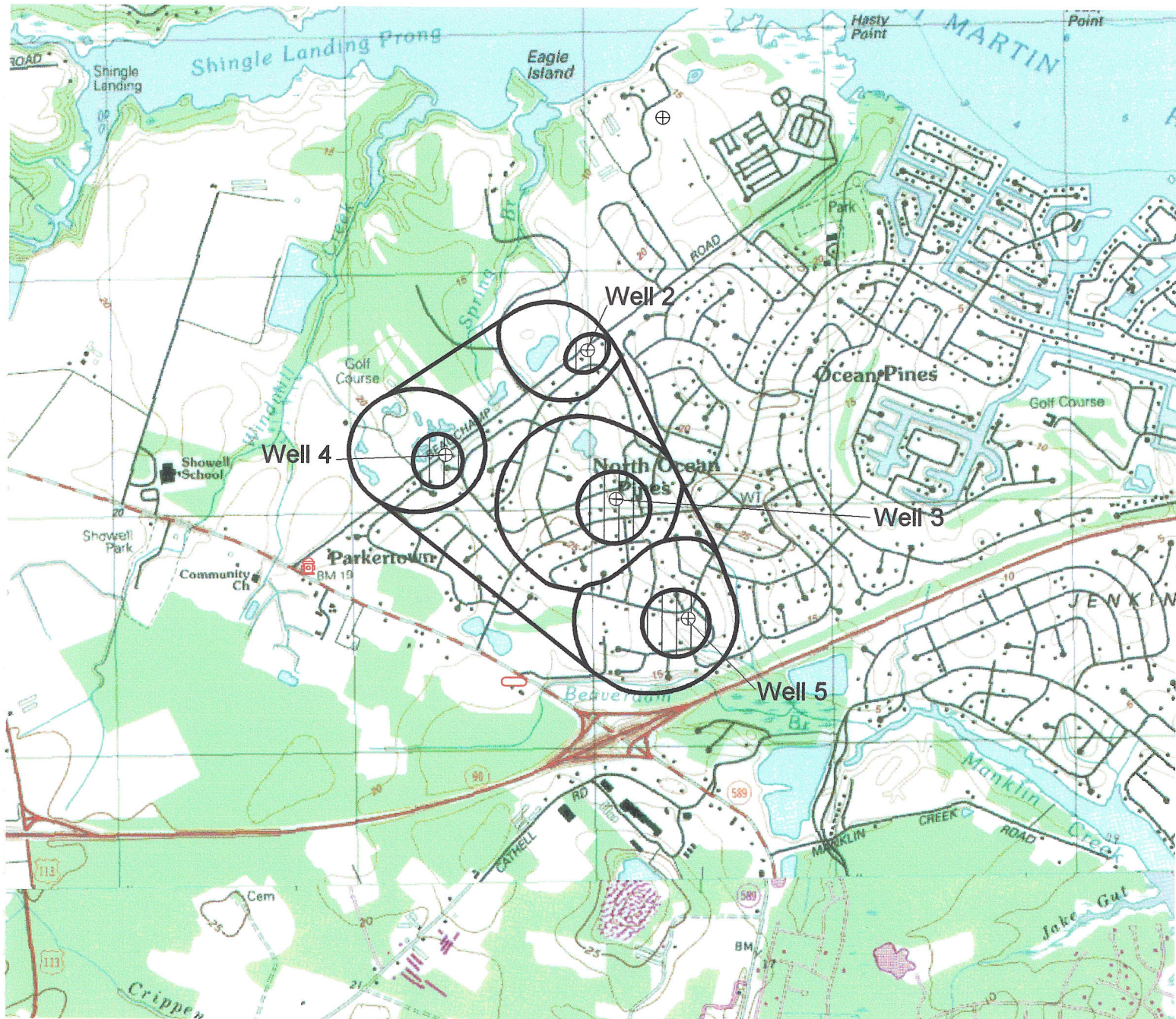
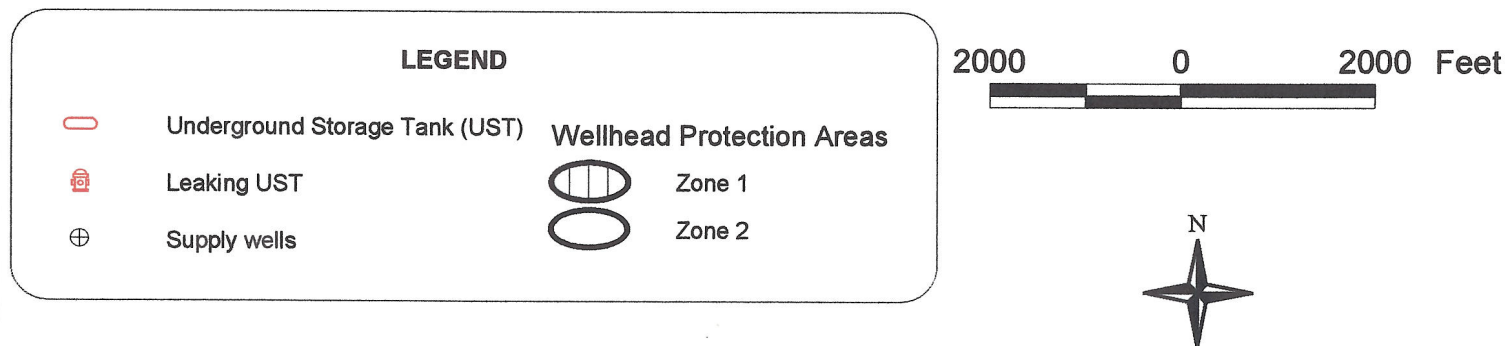


Figure 2. Ocean Pines Wellhead Protection Area with Potential Contaminant Sites



Base Map: USGS Topographic 7.5 Minute Quadrangle - Selbyville, Del.-Md.

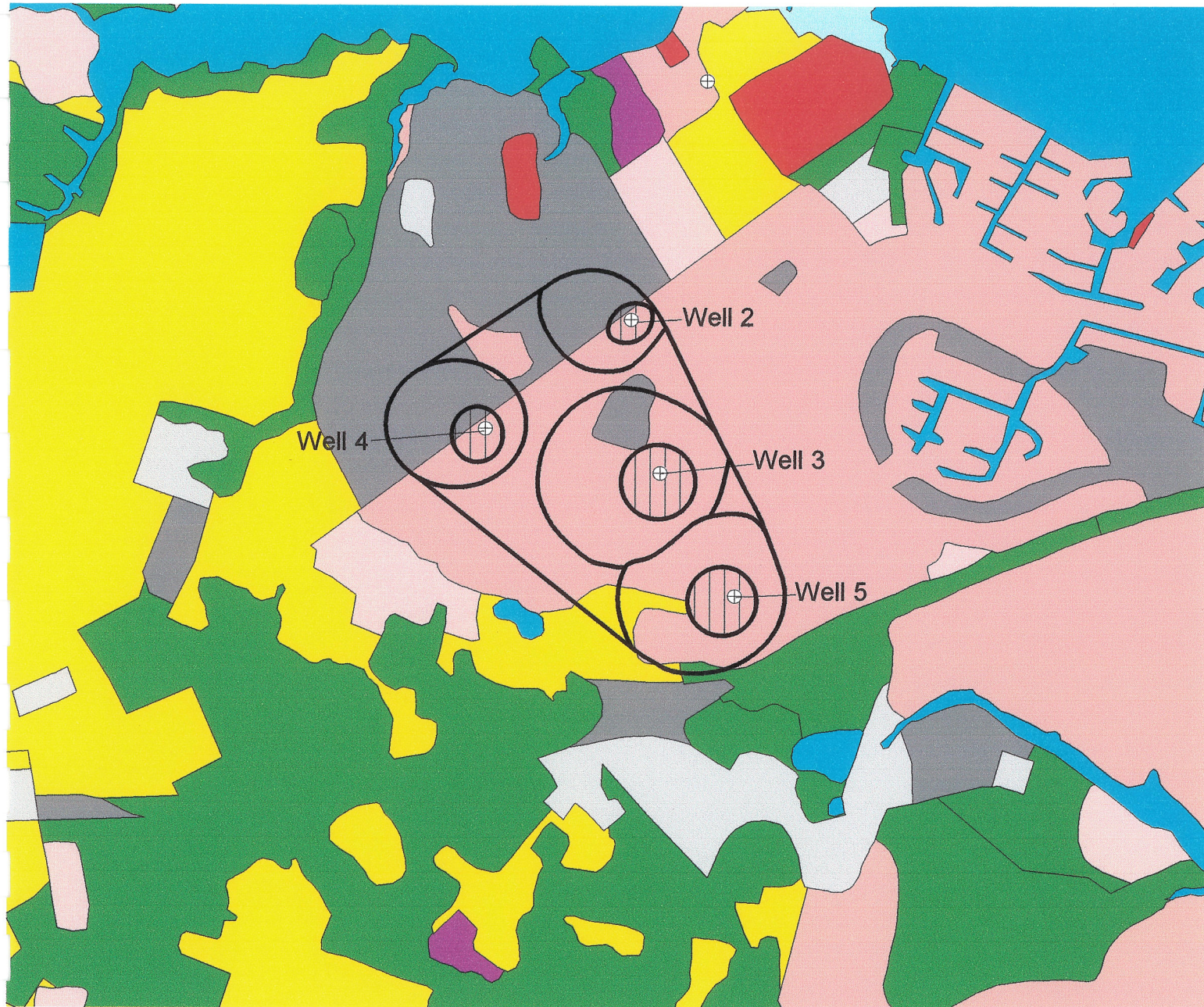
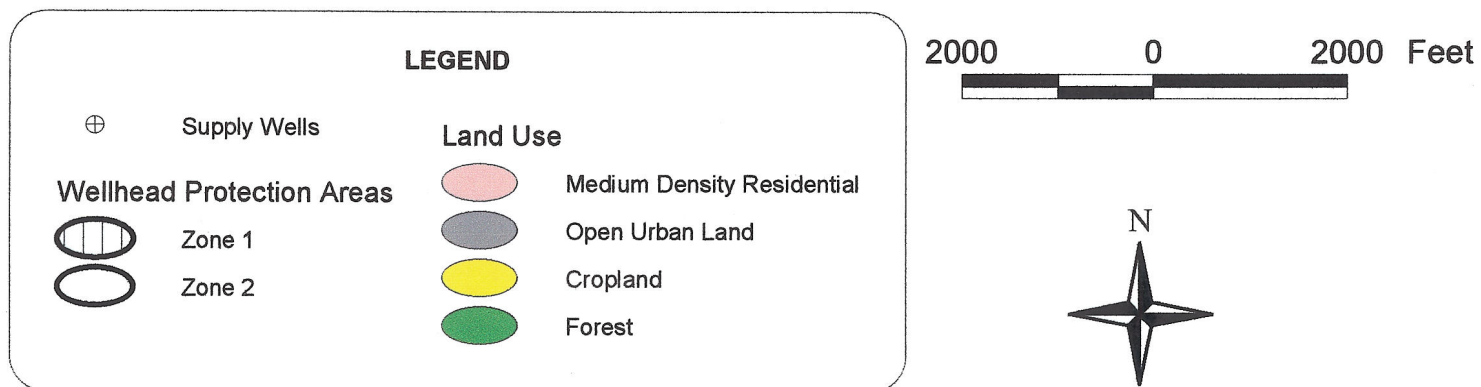


Figure 3. Land Use Map of Ocean Pines Wellhead Protection Area



Source: Maryland Office of Planning 1997 Worcester County Land Use Map

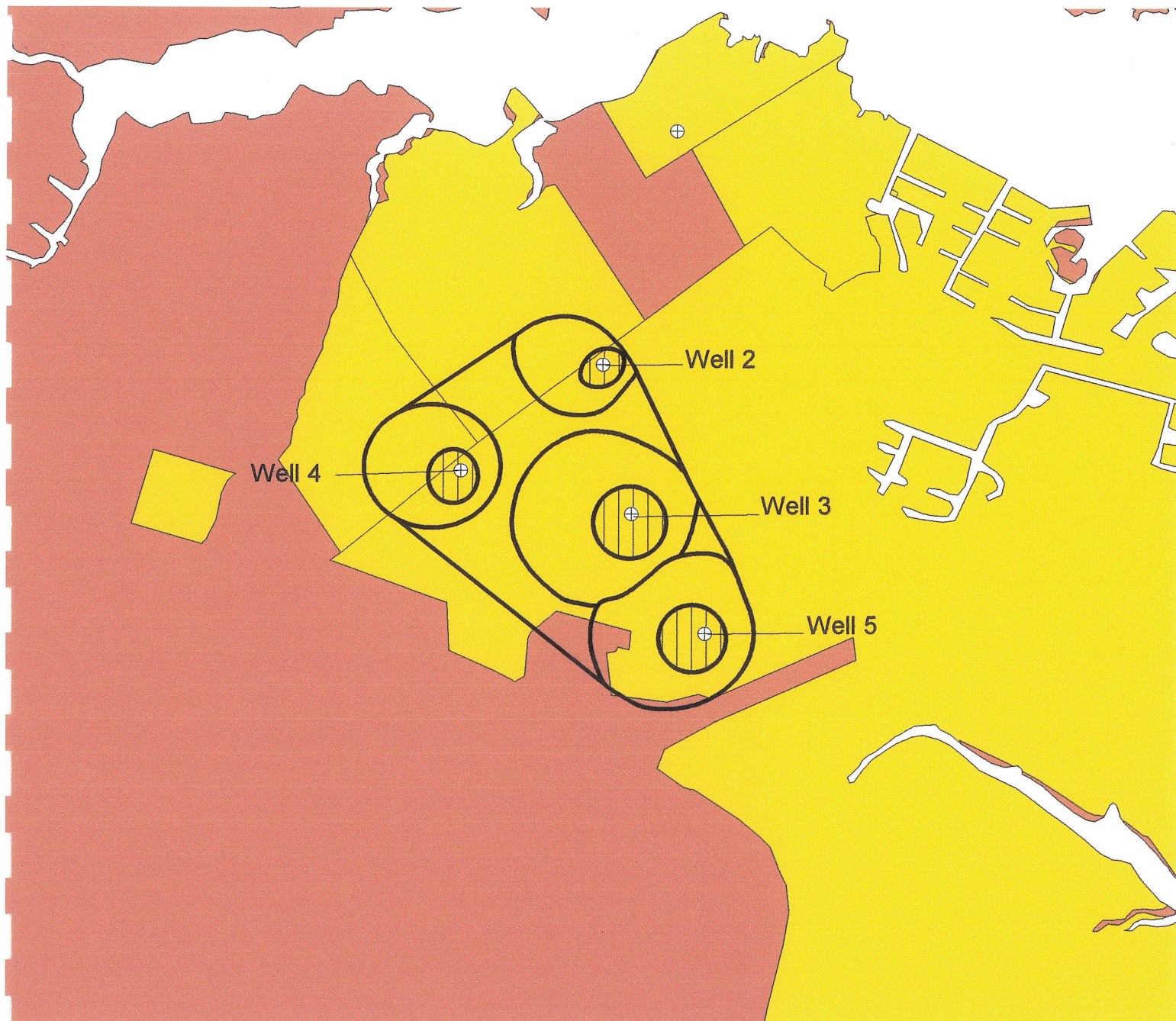
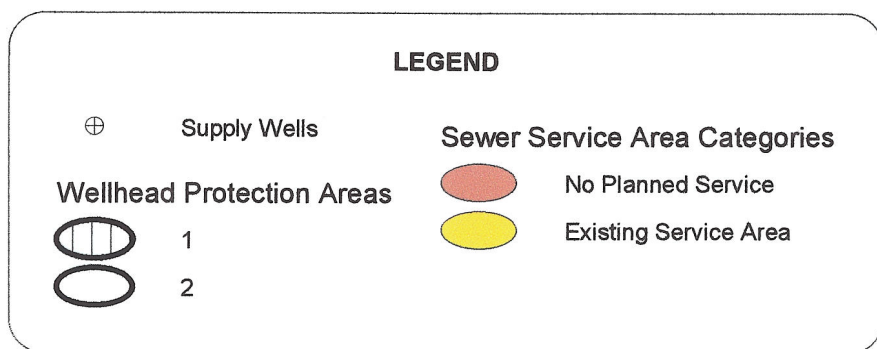


Figure 4. Sewer Service Area Map of Ocean Pines Wellhead Protection Area



Source: Maryland Office of Planning 1995 Worcester County Sewer Map

